TERTIARY PENGUINS FROM THE DUINEFONTEIN SITE, CAPE PROVINCE, SOUTH AFRICA

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(With 3 figures and 1 table)

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ABSTRACT

Penguin bones of possible Miocene age were found in excavations for a nuclear power plant about 25 km north of Cape Town. At least two species are present, but the smaller species cannot be more precisely identified than as spheniscid. The larger species is represented by tarsometatarsi with a single metatarsal foramen between the second and third metatarsals, an arrangement hitherto unknown among penguins. A new genus and species *Nucleornis insolitus* is based on these specimens.

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INTRODUCTION

In 1978 penguin bones were found in excavations for the Koeberg Nuclear Power Station on the farm Duinefontein a few kilometres north of Melkbos (or Melkbosstrand), which is about 25 km north of Cape Town. These bones came from two excavations, one for the reactor and one for a pump station. The stratigraphic section is essentially the same in the two excavations. Between about 5 and 9,4 metres above mean sea-level there are fine quartzose dune sands and a palaeosol calcrete of late Pleistocene age from which vertebrate fossils and Palaeolithic artefacts were recovered (Hendey 1968; Klein 1976). From about three metres above sea-level down to Precambrian bedrock at eleven metres below that level there is a complex of marine deposits. In this complex at about 8,2 to 8,5 metres below sea-level there is a bed of coarse quartzose sand in which were found whale debris, sharks' teeth and other fish debris, and the penguin bones described in this paper. The age of this bed has not yet been determined, but Hendey (pers. comm.) suggests that it may correlate with late Tertiary deposits elsewhere in the general vicinity and tentatively considered Miocene in age, for example at Ysterplaat, where penguin bones were also found (Simpson 1973).

The specimens here described are in the South African Museum and they are designated as in that museum's catalogue, prefixed by SAM–PQ.

Measurements are in millimetres.

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SYSTEMATICS

Order SPHENISCIFORMES

Family **Spheniscidae**

Nucleornis gen. nov.

Etymology

Nucle- is a reference to the serendipitous association of this discovery with a nuclear power station. *Ornis* is the common neo-Latin use of the Greek word for 'bird'. The generic name is masculine.

Type-species

Nucleornis insolitus sp. nov.

Included species

Type only.

Known distribution

?Miocene at the Koeberg Nuclear Power Station, Cape Province, South Africa.

Diagnosis

Tarsometatareus short and stout. A single intermetatarsal foramen between the second and third metatarsals, plantar opening immediately distal to the inner calcaneal ridge.

Discussion

This position of a single intermetatarsal foramen is not known to occur in any other penguin, living or fossil. In all six living genera there are usually two such foramina, one inner or medial foramen between the second and third metatarsals, and one outer or lateral between the third and fourth metatarsals. In *Aptenodytes* and *Pygoscelis* the two are approximately equal and both open on the plantar surface, the medial foramen just distal to the inner calcaneal ridge, and the lateral foramen at the same level and below the less salient outer prominence or ridge. In the other living genera, *Megadyptes*, *Spheniscus*, *Eudyptes*, and *Eudyptula*, the inner foramen is smaller than the outer foramen and is a small, comparatively long canal that does not open on the plantar surface, strictly speaking, but on the medial surface of the bone and, here, between the inner calcaneal ridge and the shaft of the second metatarsal. According to Watson (1893) the small inner foramen or canal is sometimes absent in *Spheniscus*, and according to Marples (1952) it is also sometimes absent in *Eudyptula*. There is then only one such foramen, the outer or more lateral of the two. (This variant does not occur in specimens of those genera that have been examined.)

In the two genera named from the late Tertiary of Cape Province, *Inguza*

has the foramina about as in *Pygoscelis*, and *Dege* has it intermediate in position between those of *Pygoscelis* and of *Spheniscus* (Simpson 1975, 1979). Among older known fossil penguins some have two foramina differing only in detail from those of *Aptenodytes* and *Pygoscelis*. That is true, for instance, of *Paraptenodytes* from the early Miocene of Argentina (Simpson 1946) and *Archaeospheniscus* from the early Oligocene of New Zealand (Simpson 1971*a*), and the probable late Eocene of Seymour Island, Antarctica (Simpson 1971*b*). Others, however, have a lateral foramen present and the medial or inner foramen small or, more commonly, absent, notably *Palaeeudyptes* from the early Tertiary of New Zealand (Marples 1952; Simpson 1971*a*) and *Palaeospheniscus* from the early Miocene of Argentina (Ameghino 1905; Simpson 1972). Until now no spheniscid tarsometatarsus was known to have a single medial or inner foramen. Some fossil genera have been named on the basis of bones other than the tarsometatarsus, usually the humerus, and for some of those the tarsometatarsus is not known. It is possible that some had a single medial foramen, but no such occurrence has been known hitherto.

The presence of such an unpenguin-like character in what is clearly a penguin tarsometatarsus seemed almost unbelievable on beginning this study. The possibility that a lateral foramen had been mistaken for a medial one had to be considered. That would be possible if a left tarsometatarsus were taken for a right or if the plantar face were taken for the dorsal or anterior face, but in this case that is not possible. In other respects the tarsometatarsus of *Nucleornis* is a mère variant of a completely spheniscid pattern. The shaft of the second metatarsal is curved, that of the fourth straight. The prominent inner calcaneal ridge is medial, and the much less prominent ridge is lateral. There are deep grooves between the metatarsals on the dorsal or anterior face, none on the plantar face. The proximal articulation for the tibiotarsus is also asymmetrical exactly as on the right tarsometatarsus of other penguins. The holotype of the type-species is certainly a right tarsometatarsus and its single foramen is certainly medial. The possibility that this is an unusual variant or perhaps teratological is also effectively ruled out by the fact that there are two specimens surely of different individuals and exactly alike in this remarkable character. The functional significance, if any, is unknown.

The type-species *Nucleornis insolitus* may be within the possible size range of *Palaeospheniscus? huxleyorum* Simpson 1973, also from the Cape Province and possibly of about the same geological age. The latter species was based on humeri and its tarsometatarsus is unknown. The humerus of *Nucleornis insolitus* is unknown. Thus the possibility that the species are synonymous cannot be entirely ruled out. That does not affect the validity of the genus *Nucleornis*, which cannot be synonymous with *Palaeospheniscus* or any other genus in which the tarsometatarsus is known. The clearly valid generic name must be linked with a type-species known to have its generic characters. Under these circumstances a new specific name must be proposed despite the slight possibility that it could be synonymous with *P.? huxleyorum*.

Nucleornis insolitus sp. nov.

Etymology

Insolitus, Latin, 'unusual', 'strange', because of the unusual presence of a single medial intermetatarsal foramen.

Holotype

MBD4, right tarsometatarsal lacking the distal ends of the second and third metatarsals (Fig. 1).

Fig. 1. *Nucleornis insolitus*, type, tarsometatarsus SAM–PQ–MBD4. Proximal, dorsal and plantar views.

Hypodigm

The holotype and MBD3, right tarsometatarsal lacking the part proximal to the fourth metatarsal and the distal end of the second metatarsal (Fig. 2).

Known distribution

As for the genus.

Diagnosis

Only known species of the genus. Measurements as in Table 1.

TABLE 1

Measurements of Tarsometatarsi of *Nucleornis insolitus*

	MBD4, holotype	MBD3
Width across proximal end	19,9	—
Width about one-fourth of distance from proximal end	19,9	21,6
Width of distal end of third metatarsal	—	9,0
Length of third metatarsal to distal groove	—	40,4
Length of fourth metatarsal to distal groove	31,3	—

Fig. 2. *Nucleornis insolitus*, tarsometatarsus SAM–PQ–MBD3. Dorsal and plantar views.

Discussion

Although MBD3 is somewhat more nearly complete, MBD4 has crucial structure better preserved and is therefore selected as the holotype. MBD4 is slightly smaller than MBD3 but the morphology is almost identical in the two and the difference in size is well within the expected size range of this bone in a single species of penguins.

MBD7 from the same deposit is a right radius of size appropriate for this species and probably belonging to it. It lacks the distal end. The part preserved is characteristically spheniscid but does not clearly show any particularly distinctive features. As reference to the species is not certain and it would add no diagnostic characters, it is not included in the hypodigm.

Gen. et sp. indet.

Material

MBD70, left humerus, proximal and distal ends incomplete. This bone is from the excavation for the reactor and all the others are from that for the pump station, but as noted above all are from the same bed (Fig. 3).

MBD10, right humerus, so badly abraded as to have little remaining character.

MBD1, left tibiotarsus, lacking proximal end.

MBD2, left coracoid, lacking posterior end.

Discussion

These bones could all belong to a single species, although there is no assurance that they do so. None can be confidently identified to genus or species. They are all definitely too small to belong to *Nucleornis insolitus*.

MBD70 is a short, relatively light humerus, probably with a bipartite tricipital fossa, with a gently but definitely curving shaft distinctly wider toward the distal end and without a preaxial angulation. This specimen falls just short of permitting identification but suggests that it represents a distinct species. It is not referable to *Palaeospheniscus? huxleyorum*, based on a humerus and of possibly near the same age at Ysterplaat, MBD70 being somewhat smaller, with shaft more distinctly curved and with a greater difference between proximal and distal widths. The very poorly preserved humerus MBD10 might be of the same species as MBD70.

Fig. 3. Spheniscidae indet., humerus SAM–PQ–MBD70.
Medial view.

The coracoids of penguins are often characteristic at a generic or even a specific level. This is seldom of diagnostic use for fossil penguins because articulated or associated skeletons of fossil penguins are extremely rare, almost all named taxa are based on the humerus or the tarsometatarous, and few fossil coracoids are definitely referable to a defined genus or species. It has frequently been noticed (e.g. Marples 1952; Zusi 1975) that in living penguins there are two quite distinct patterns of coracoids, one, in *Pygoscelis* and *Aptenodytes*, without a fenestra, and one, in the other living genera, with a fenestra. Although because of breakage this is not quite certain, MBD2 seems to have had a fenestra. As with many other spheniscid characters it is not yet clear which, if either, of these states was primitive and which is derived or whether both are.

There are three other specimens in the collection that are probably fragments of penguin bones but are entirely unidentifiable: MBD8, MBD9, and MBD11.

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